

What is claimed is:

1. A projection optical system which projects luminous flux from an original image onto a projection surface oblique to a central principal ray which is a principal ray of luminous flux traveling from the center of the original image to the center of a projected image, the projection optical system comprising:

a refractive optical system which includes a plurality of refractive optical elements through which the luminous flux from the original image passes through; and

a reflective optical system which includes a plurality of reflective surfaces and guides the luminous flux emerging from the refractive optical system to the projection surface, each of the surfaces having an optical power.

2. The projection optical system according to claim 1, wherein an intermediate image of the original image is formed within the reflective optical system.

3. The projection optical system according to claim 2, wherein at least one of optical surfaces each having an optical power disposed immediately before and after the position where the intermediate image is formed is a reflective surface.

4. The projection optical system according to claim 2,

wherein an optical surface having an optical power closest to the position where the intermediate image is formed is a reflective surface.

5. The projection optical system according to claim 1, wherein the following expression is satisfied:

$$|f_a/f| > 2$$

where  $f_a$  represents a focal length of the refractive optical system and  $f$  represents a focal length of the projection optical system in a longitudinal direction of the projection surface.

6. The projection optical system according to claim 1, wherein at least one of the reflective surfaces is a rotationally asymmetric surface.

7. The projection optical system according to claim 2, wherein at least one of optical surfaces each having an optical power disposed immediately before and after the position where the intermediate image is formed has an asymmetric optical power in azimuthal directions of 0 and 90 degrees.

8. The projection optical system according to claim 2, wherein each of optical surfaces each having an optical power disposed immediately before and after the position where the intermediate image is formed is shaped in

azimuthal directions of 0 and 90 degrees such that the surface has a concave shape toward each of the azimuthal directions when the refractive optical system has negative curvature of field.

9. The projection optical system according to claim 2, wherein each of optical surfaces each having an optical power disposed immediately before and after the position where the intermediate image is formed is shaped in azimuthal directions of 0 and 90 degrees such that the surface has a convex shape toward each of the azimuthal directions when the refractive optical system has positive curvature of field.

10. The projection optical system according to claim 1, wherein a normal line to a surface of the original image is substantially perpendicular to a normal line to the projection surface.

11. The projection optical system according to claim 1, wherein an optical axis of the refractive optical system is substantially perpendicular to a normal line to the projection surface.

12. The projection optical system according to claim 11, wherein the optical axis of the refractive optical system is substantially parallel to a normal line to a plane including

a reference axis which is an optical path of the central principal ray within the reflective optical system.

13. The projection optical system according to claim 11, wherein the optical axis of the refractive optical system is substantially perpendicular to a normal line to a plane including a reference axis which is an optical path of the central principal ray within the reflective optical system.

14. A projection type image display apparatus comprising:  
an image forming element which forms an original image; and

the projection optical system according to claim 1, which projects luminous flux from the original image onto a projection surface.

15. The projection type image display apparatus according to claim 14, further comprising a plane reflective surface provided on an optical path from the reflective optical system to the projection surface.

16. An image display system comprising:  
the projection type image display apparatus according to claim 14, and

an image information supply apparatus which supplies image information for displaying an original image on the image forming element to the projection type image display

apparatus.